CLAIMS

What is claimed is:

1.   A method of forming a hybrid mesh representation of an object surface comprising:

forming a base mesh; and

forming one or more higher level meshes from the base mesh through one or more regular refinement operations in combination with at least one irregular operation,

the hybrid mesh representation comprising the base mesh in combination with the one or more higher level meshes.

2.   The method of claim 1 wherein the base mesh is a regular mesh.

3.   The method of claim 1 wherein the base mesh is an irregular mesh.

4.   The method of claim 1 wherein the meshes each comprise plurality of tessellated polygons.

5.   The method of claim 4 wherein the polygons are quads.

6.   The method of claim 4 wherein the polygons are triangles.

7.   The method of claim 4 wherein the polygons are hexagons.

8.   The method of claim 1 wherein the base mesh and the one or more higher level meshes have a hierarchical relationship.

9.   The method of claim 1 wherein the at least one irregular operation comprises cutting a hole in a mesh by removing polygons.

10.   The method of claim 1 wherein the at least one irregular operation comprises adding one or more polygons to a mesh.

11.   The method of claim 10 wherein the one or more polygons define a volume.

12.   The method of claim 11 wherein the volume is a cube.

13.   The method of claim 1 further comprising parameterizing one or more of the meshes.

14.   The method of claim 13 further comprising performing the at least one irregular operation after the parameterization step.

15.   A method of forming a hybrid mesh representation of an object surface comprising:

5   a step for forming a base mesh; and

a step for forming one or more higher level meshes from the base mesh through one or more regular refinement operations in combination with at least one irregular operation.

16.   The hybrid mesh representation resulting from the method of any of

10   claims 1 or 15.

17.   A hybrid mesh representation of an object surface comprising:

a base mesh comprising a plurality of patches; and

one or more higher level meshes in a hierarchical relationship with the base mesh,

15   at least one of the higher level meshes representing a patch in the base mesh being an irregular mesh.

18.   The hybrid mesh representation of claim 17 wherein the base mesh is a regular mesh.

19.   The hybrid mesh representation of claim 17 wherein the base mesh is

20   an irregular mesh.

20.   The hybrid mesh representation of any of claims 16 or 17 which is tangibly embodied on or in a processor readable medium.

21.   The hybrid mesh representation of any of claims 16 or 17 which is tangibly embodied on or in a memory.

25   22.   A data structure corresponding to a root polygon in a mesh representation, the polygon having vertices, one or more neighboring polygons, and, optionally, one or more child polygons, comprising:

a pointer to each of the vertices of the root polygon;

a pointer to each of the neighboring polygons or data structures corresponding

30   thereto; and

a pointer to any child polygons or data structures corresponding thereto.

23. The data structure of claim 22 wherein the root polygon is a quad.

24. The data structure of claim 22 wherein the root polygon is a triangle.

25. The data structure of claim 22 wherein the root polygon is a hexagon.

26. The data structure of claim 22 wherein the root polygon is part of a base mesh.

27. The data structure of claim 22 wherein the root polygon is part of a higher level mesh.

28. The data structure of claim 27 wherein the higher level mesh is part of a hybrid mesh.

29. The data structure of claim 26 wherein the base mesh is part of a higher level mesh.

30. The data structure of claim 22 tangibly embodied on or in a processor readable medium.

31. The data structure of claim 22 tangibly embodied on or in a memory.

32. A data structure corresponding to a child polygon in a mesh representation, the child polygon having vertices, a parent polygon, and, optionally, one or more second child polygons, comprising:

a pointer to the parent polygon or a data structure corresponding thereto;

a pointer to each of the vertices of the child polygon; and

a pointer to any second child polygons or data structures corresponding thereto.

33. The data structure of claim 32 wherein the child polygon is part of a hybrid mesh.

34. The data structure of claim 32 tangibly embodied on or in a processor readable medium.

35. The data structure of claim 32 tangibly embodied on or in a memory.

36. The data structure of claim 32 further comprising a flag having first and second states for indicating whether or not the child polygon has been removed from the mesh representation.

37.   A method of replacing a first polygon in a mesh representation with a plurality of second polygons comprising:

placing a flag in a state indicating that the first polygon has been removed from the mesh representation, the flag being part of a data structure corresponding to the first polygon, the data structure also having pointers to any polygons that are children of the first polygon;

adding the second polygons to the mesh representation; and

modifying the pointers in the data structure corresponding to the first polygon so that they point to the second polygons or data structures corresponding thereto.

38.   The method of claim 37 wherein the first polygon is part of a higher level mesh representation.

39.   The method of claim 38 wherein the higher level mesh representation is part of a hybrid mesh representation.

40.   A data structure corresponding to a virtual root polygon in a mesh representation, the virtual root polygon having vertices and corresponding to a removed child polygon having neighbors, and one or more added polygons which are neighbors of the neighbors of the removed child polygon, comprising:

a pointer to each of the vertices of the virtual root polygon; and

a pointer to each of the added polygons which are neighbors of the neighbors of the removed child polygon.

41.   The data structure of claim 40 tangibly embodied on or in a processor readable medium.

42.   The data structure of claim 40 tangibly embodied on or in a memory.

43.   A method of compressing a hybrid mesh representation of an object surface comprising:

applying a wavelet transform to transform the hybrid mesh representation into one or more wavelet coefficients; and

encoding the wavelet coefficients with a progressive encoding algorithm.

44.   The method of claim 43 wherein the progressive encoding algorithm is a zero-tree algorithm.

45.   The method of claim 43 further comprising encoding one or more of the irregular operations which are performed in creating the hybrid mesh representation.

46.   A method of de-compressing a coded form of a hybrid mesh representation of an object surface comprising:

applying a progressive decoding algorithm to the coded mesh to recover one or more wavelet coefficients; and

applying an inverse wavelet transform algorithm to the one or more coefficients to obtain a full or partial reconstruction of the object surface.

47.   The method of claim 46 where the progressive decoding algorithm is a zero-tree algorithm.

48.   The method of claim 46 further comprising decoding and performing one or more irregular operations to obtain the full or partial reconstruction.